Novel Nanotechnology for the Detection of Circulating Tumor Cells

Wu, Alyssa (School: Chamblee Charter High School)

The presence of circulating tumor cells (CTCs) in a patient's blood may indicate the aggressiveness of metastatic cancer, and the detection of CTCs can assist physicians in decision making and improving clinical outcomes. However, a highly specific and sensitive CTC assay to isolate and identify CTCs from blood samples is still lacking. The technology used by surface-enhanced Raman scattering (SERS) nanoparticles that are conjugated with epidermal growth factor (EGF) peptide or epithelial cell adhesion molecule (EpCAM) antibody provide a potential solution. The EGF-SERS or EpCAM-SERS nanoparticles can recognize two important biomarkers on the surface of human head and neck cancer, i.e., EGF receptor and EpCAM on CTCs in blood samples, respectively. Blood samples were collected from 16 cancer patients, and positive SERS signals were detected in 11 out of 16 patients. Interestingly, the EpCAM-SERS nanoparticles detected positive signals in 4 cancer patient samples tested as negative by the EGF-SERS nanoparticles, and the EGF-SERS nanoparticles could detect signals from 5 patient samples negative in the EpCAM-SERS assay. This high heterogeneity in SERS profile was further demonstrated by immunofluorescence staining in cultured human cancer cells as well as immunohistochemistry in fixed human tumor tissues and CTCs. Taken together, this work shows the potential of multiplex SERS nanoparticles as a sensitive, specific, and flexible platform for non-invasive detection of CTCs and quantitation of cancer biomarkers. For future studies, larger numbers of patient samples are needed to validate the clinical use of this novel nanotechnology in cancer diagnosis.

Awards Won: